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ABSTRACT

This study attempts to identify potential school problems in preschool children in order to facilitate the provision of relevant information for systematic screening and early guidance. Data from the first 14 months (to the end of the preschool period) of a longitudinal study extending from 4 1/2 years of age to the end of second grade are reported. The children were tested twice. At the mean age of 58 months various individual tests for cognitive, linguistic and perceptual development were administered. Classroom behavior was rated by the teacher and neuromotoric functioning was examined by the school doctor. One year later at a mean age of 72 months, the tests and classroom observations were repeated. Results showed almost no sex differences in IQ, linguistic competence, or other aspects of cognitive functioning. Boys and girls were equally represented in the at risk group. Age differences were far more pronounced in the first part of the study than in the second. Socioeconomic status had an increasing influence on test results over the 14 months. Changes in cognitive development were significantly related to socioeconomic status and school. The age of the child and behavior ratings of the teacher made no independent contribution to the predictability of change. Socioeconomic status was strongly related to whether young preschoolers at risk for school problems showed improvement in the preschool period or not. (Author/JMB)

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On the stability and predictability of cognitive development in the preschool period.

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1. Introduction

In the Netherlands about 95% of all children between 4 and 5 years of age attend preschool. Two years later they go to elementary school, where a more formal education starts. Emphasis is then put on reading and arithmetic. Usually procedures for the early recognition of potential schoolproblems are introduced during the period of transition from preschool to elementary school and then they have the character of placement decisions. This means that two years pass before systematic efforts for the detection of problems are undertaken.
The aim of this study was to seek in the early preschool period for antecedents of problems in elementary school. In this way information could be made available for systematic screening and early guidance in preschool.
In this study we concentrate on cognitive aspects of the child's development as does today's educational system. The study however also includes background variables such as the social, motivational and emotional functioning of the child in the classroom. The presence or absence of symptoms of neurological abnormalities is also taken into account. The general outline of the study is to follow a group of preschoolers in their development untill they are in the second grade of elementary school and have been tought the essentials of reading and arithmetic.
Our goal is not only to validate the predictive power of a battery of tests. We also want to study the process of the development of schoolproblems. Therefore our population is examined at least once each year.
This paper covers the preschool period up to the time the children start elementary school.

2. Method

2.1 Design of the study

The study started in 5 preschools in the suburban city "Capelle aan de IJssel". All 117 children who at September 1, 1976 were between 4 and 5 years old participated. At the mean age of 58 months a variety of individual tests for cognitive, linguistic and perceptual development were administered. Classroom behaviour was rated by the teacher and neuromotoric functioning was examined by the schooldoctor.

One year later at a mean age of 72 months the tests and classroom-observations were repeated. In further stages of the study (not included in this paper) school achievements and behaviour of the children in elementary school is evaluated twice yearly.

2.2 Subjects

The 58 boys and 59 girls came from 11 different classrooms. Mainly because a number of families moved to other cities, in the second stage of the study only 101 (86%) children remained in the sample. The socio-economic status (SES) of the child's family, as expressed by father's occupation was rated on a six-point scale. The SES distribution in the sample is given in table 1, where also the distribution in a national sample of first-graders is included (Claessen and Smits 1974). It can be seen that our sample is skewed at the two extremes. The unskilled and skilled labour levels are underrepresented in favour of the highest level.

Table 1. SES-distribution (percentages) in the sample compared to a national sample of first graders.

	our sample (N = 117)	national sample (N = 686)
	%	%
1. unskilled labour	3	14
2. skilled labour	26	39
3. lower employees	18	19
4. small tradesman	12	17
5. middle level professions	7	5
6. academic and higher professions	31	6
unknown	3	

2.3 Variables studied

2.3.1 Individual tests for cognitive, linguistic and perceptual development.

The following tests were used.

a) a non-verbal intelligence test with the subtests: sorting, mosaïc, puzzles, memory and figure copying: the Snijders-Oomen non-verbal IQ-test.

b) a test for linguistic competence with the subtests: vocabulary, analogies and opposites, grammar and fluency: the Utrechtse Taalniveau Test.
c) a visual word recognition task (a subtest from the Gates Reading Readiness Tests).
d) a spatial oriëntation test (connecting points on a paper, a subtest from the Frostig Developmental test of visual perception).
e) the subtest "Sentence Memory from the Stanford Binet".
f) a test "Picture Naming".

The selection of these variables was mainly based on the results of the longitudinal studies from Jansky and de Hirsch (1972). In their work a selection was made of those aspects of cognitive functioning of 5 years old that best predicted later school progress. The most important difference in our study is that the full-scale language test and the non-verbal IQ were added.
In this paper we tentatively assume that these variables are related to later school-functioning.
The raw scores of each subtest of the intelligence test, the subtests of the language test and the 4 other tests were converted into standard scores (i.e. z-scores with a mean of 0 and a standard deviation of 1). For these 13 variables also a mean of the standard skores was completed as an overall-measure of the child's cognitive functioning. This score was named the Overall Standard Score. In addition IQ-scores and full-scale language test scores were used.
Thus 13 specific scores and three composite scores were used.

2.3.2 Behaviour in the classroom.

Independently of these tests the teacher completed a behaviour rating scale.
There were 49 items, referring to various aspects of the child's classroom behaviour. The item range was 1 to 5, with the higher rating indicating more favourable behaviour. This observation list for preschoolers can be seen as an extension of the Student Rating Scale from Feshbach e.o.(1974).

The following a priori structure of the scales was supported by factor-analysis. (Hermans & Cools, 1978)

1. Task-directedness and independence from the teacher (for example "Can the child complete a task on its own").
2. Adaptive behaviour (for example "Does the child follow the rules of the classroom).
3. Communicative competence (for example "Is the vocabulary of the child large enough to express feelings and thoughts").
4. Motor-coördination (for example "Does the child play skillfully with a ball").
5. Perceptual competence (for example "Is the child able to react differentially to the primary colours").

2.3.2 Neuromotoric examination

The neuromotoric examination of the schooldoctor was a shortened version of the method of Touwen and Prechtl (1970). Items were among others choreatoform movements, symmetry of motoric patterns, fixation and convergence of the eyes etcetera.
In this paper only a dichotomeous end result (absence or presence of abnormalities) is used.

3. Results

First I will discuss the influence of the variables sex, SES and age on the testresult in both stages of the study. Then the relation of a number of variables to changes in the testscores in the one-year period will be looked at.
Special attention is paid to the children who have the lowest scores on the tests for cognitive development.

3.1 The influence of sex, age and SES on the testresults

The sex of the children had almost no effect on the results of the cognitive tests. Of all 26 specific or 6 composite variables only one showed a significant effect in favour of the girls: the subtest vocabulary at the end of the preschool period (T-test, $p < .01$).
The influence of the variable age of the child expressed in months was analysed by a one-way analysis of variance. A significant age effect ($p < .05$) was found at the younger age in 9 of the 12 specific variables, in the full-scale language score and in the over-all standard score.

One year later the scores on only two subtests and on the over-all standard score did show a relation to age.* It seems that in the course of preschool education age-differences are diminishing.
The influence of the SES-variable shows an opposite trend. At the beginning of the study the results of only three of the subtests, the full scale language score and the overall-standard score were significantly influenced by SES (one-way analysis of variance, $p < .05$).
One year later 6 of the subtests and all three the composite variables showed this effect. The socio-economic level of the family seems to have an increasing influence during preschool education.
The diminishing influence of age and the increasing SES-influence is also shown by the Pearson correlation coëfficiëntsbetween these variables and the testresults in both stages of the study (see table 2).

Table 2. Pearson correlations** between age and SES x the three composite scores in both stages of the study (N = 101).

	SES	Age
first IQ	.18	-
second IQ	.34	-
first language test	.30	.39
second language test	.39	.21
first overall-score	.21	.50
second overall-score	.40	.32

The finding that SES influences testresults to this extent is surprising You may recall that only 3% of the children came from homes where the father was an unskilled labourer. A second point is that SES had more influence at the end of the preschool period than one year earlier.

In the next section I will discuss the relationship between SES, other variables and changes in individual testscores.

3.2 SES, age and classroom behaviour in relation to progress in cognitive development

The stability of the three composite scores as expressed by Pearson correlations between scores at the two stages of the study is described in table 3.

* no ceiling effects were found
** all correlations significant at least at $p < .05$

Table 3. Pearson correlations between testresults in both stages of the study (N = 101).

IQ	.51
Language test	.76
Overall score	.76.

The stability of the testresults is not very impressive.
The IQ-scores in particular seem to have changed a lot.

To investigate wether there were systematic influences on this change a multiple regression analysis was performed to see how well the second score on a particular test could be predicted from SES, age and behaviour rating (in this order) after that the influence of the first score was eliminated and thus was held constant. The mean total score of the behaviour ratings was used. In preliminary analyses the 6 subscales were introduced separately and in different combinations. This did however not make any difference. For reason of simplicity the mean total score is used in the following analysis.
I will first discuss the results in relation to the IQ-scores. In order to make these scores comparable to those of the other two composite tests not IQ's, but mean standard score of the 5 subtests was used. In table 4 the stepwise multiple regression is summarized.

Table 4. Stepwise Multiple Regression Analyses with intelligence test scores as dependent variable (N = 96).

	Multiple R	Significance of change
first IQ	.60	.001
SES	.64	.001
Age	.66	.04
Classroom behaviour	.68	.02

It turns out that SES, age and behaviour rating each makes an independent contribution tot the prediction of the second IQ-score. In table 5 the same analyses is given for the full-scale language score.

Table 5:Stepwise Multiple Regression Analysis with full-scale language score as dependent variable (N = 96).

	Multiple	Significance of change
first language score	.76	-
SES	.78	.01
Age	.78	-
Classroom behaviour	.78	-

In the case of the language test only the SES appears to be related to changes in achievement.
In table 6 the findings for the overall standard scores are given. There also the SES is the only variable that contributes significantly to prediction.

Table 6. Stepwise Multiple Regression Analysis with Overall Standard Score as dependent variable (N = 96).

	Multiple	Significance of change
first overall score	.76	-
SES	.79	.001
Age	.80	-
Behaviour rating	.80	-

From these three tables it becomes clear that in the sample studied SES was related to changes in testscores. Stated simply: progress or decline in intelligence score, language testscores and overall test-scores is related to the occuption of the father. It was also found that the classroom behaviour rating by the teacher gives no extra information on this subject. Only in the case of the IQ-test was a small influence found. To investigate the role of the specific school the above described analyses were repeated with school as a fifth independent variable. The 5 schools were introduced as dummy variables. Wit respect to IQ, no significant improvement in prediction was achieved. As to the language test the Multiple R rose from .78 to .86 (significant at $p < .001$). The multiple R for the overall standard score improved significantly ($p < .001$) from .80 to .85.
It turns out that the particular school the child visits makes a significant contribution to cognitive development even if age, SES and judgement of the teacher are held constant.
We conclude from this that IQ, Language testscores and overall tests-scores are of moderate stability in the age period studied. The predicatbility of the scores is however much greater if environmental factors such as SES and type of school are taken into account.

The behaviour of the child in the classroom as rated by the teacher provides little extra information. The same is true for the age of the child. Now let us see if this information is of help in the early detection of schoolproblems.

3.3 The stability and predictability of the "at risk" development

In the first stage of the study a number of children "at risk for schoolproblems" were selected. This selection was done in two ways. One based on low overal functioning, the other on the presence of specific problems. The former consisted of selecting all children whose overall standard score was < -1. According to the latter method the children who on at least 3 of the specific subtests scored below the 10th percentile were called "at risk". By the first method 14% of the children were selected; by the second 12%. The first group included all the children from the second group plus two others. A distinction between overall low functioning versus specific defects thus seems superfluous. The following analyses are done with the larger group, consisting of 17 children. Boys and girls were almost equally represented (8 vs 9). In the sample as a whole 49% of the children came from the lower half of the SES distribution. In the at-risk group 12 of 17 children came from the lowest 3 SES-levels and the other 5 from the 3 highest levels.
In the second stage of the study another at risk group was formed in the same way. Now there were 18 children (18%) who met the criteria. The stability of low scores on the tests proved to be moderate. Only 11 of the 17 children remained in the at risk group (65%). The predictability was however considerable increased by taking SES into account. Table 7 shows the results.

Table 7. Stability of at risk functioning in relation to SES*

	SES		
	lower half	upper half	total
remained at risk	10	1	11
positive change	2	4	6
total	12	5	17

It can be seen that the stability within the lower three levels is much higher (about 80%) than in the higher levels (about 20%). Neither age of the child, sex, behaviour rating, or school had such a relation to the stability of "at risk" scores.

* Fisher's Exact Test significant at $p < .03$.

3.4 Neuro-motor problems and the "at risk" group

Independently from the above described at risk group the schooldoctor selected children who showed signs of neurological retardation or abnormalities. Of the whole sample 90 children were seen by the schooldoctor and were also given the individual cognitive tests. Of these, 10 were put in the neurological problems group. Half of these children were in the at risk group in the first stage of the study and three in the second. Given the great differences between these different way of looking at children this overlap is striking. Assuming predicitive validity for the cognitive tests the overall contribution of the neuromotor examination to the early detection of schoolproblems however seems to be small.

4. Conclusions

The follwoing findings seem worthy of discussion:

a. The sex of the child had almost no relation to the testresults, neither at the younger preschool age, nor at the older. This is an intriguing finding. The distribution boys and girls in special education in the Netherlands is 80 vs. 20 percent respectively. In our at risk group boys and girls were equally represented. Perhaps these sex-differences begin to appear in elementary school.

b. The age of the children had a significant influence on most of the test-results at the younger ages. One year later this relation is almost gone. A tentative explanation might be that preschool education itself makes children mor homogeneous in respect to age differences.

c. At the beginning of the study socio-economic status of the child's family showed a significant influence on only 3 of the 13 specific variables. This effect was present in 7 of those variables at the end of the preschool period. The correlations between SES and test-results also increased significantly in the course of the study.

d. The stability of testresults was moderate. The predictability was improved by taking SES and school of the child into account. Of interest is that the type of school was related to change in language ability, but not to change in non-verbal IQ. Perhaps Dutch preschool education is more language directed than stimulation of spatial analytic ability.

e. The behaviour rating by the teacher involving various aspects of classroom functioning made no independent contribution to the predictability of the child's cognitive development.

Only 65% of the children who were classified as "at risk for schoolproblems" were still in the "at risk" group one year later.

The predictability for the lower half of the socio-economic distribution was however 80% for the upperhalf it was only 20%. This suggests that in predicting schoolproblems one cannot rely solely on tests or screening indices. Of the variables studied the occupation of the father was the most powerfull extra predictor.

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